

# Washington Correlator Status 2018

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**Abstract** This report summarizes the activities of the Washington Correlator for the IVS General Meeting. The Washington Correlator primarily supports Earth Orientation and astrometric observations by providing correlated output of IVS VLBI experiments.

**Keywords** Correlator, WACO

## 1 General Information

The Washington Correlator (WACO) is located at and staffed by the United States Naval Observatory (USNO) in Washington, DC, USA. The correlator is sponsored and funded by the National Earth Orientation Service (NEOS), which is a joint effort of USNO, NASA and NOAA. Dedicated to processing geodetic and astrometric VLBI observations, the facility spent 100 percent of its time on these sessions in 2017 and 2018. All of the weekly IVS-R4 sessions and all of the daily IVS-INT01 Intensives were processed at WACO. Additionally, WACO correlated some IVS-CRDS and IVS-CRF sessions, as well as daily VLBA Intensive sessions. The facility houses the WACO DiFX correlator.

## 2 Activities

The correlator staff is primarily responsible for the IVS-R4 and the IVS-INT01 Intensive sessions. From

1. United States Naval Observatory  
2. Universities Space Research Association

November 2017 through April 2018, WACO was responsible for correlating both the IVS-R1 and IVS-R4 sessions while the Bonn Astro/Geo Correlator worked through the correlation of the CONT17 sessions. In total, WACO correlated 21 IVS-R1 sessions starting with R1818 and through R1839 until Bonn resumed correlation of IVS-R1 sessions.

Daily Intensive observations from Kokee Park and Wettzell are routinely transferred via e-VLBI. 24-hour sessions from AGGO, Badary, Fortaleza, HartRAO, Hobart, Ishioka, Katherine, Kokee Park, Matera, Medicina, Noto, Ny-Ålesund, Urumqi, Warkworth, Wettzell and Wettzell North, Yebes, Yarragadee, and Zelenchukskaya are also transferred to USNO, with about 35% of the data shipped on Mark 5 diskpacks and the remainder transferred over high-speed networks.

**Table 1** Experiments correlated as of 1 August 2018.

Experiment	2017	2018 (Scheduled)
IVS-R4	50	28 (52)
IVS-INT01	233	131 (231)
IVS-R1	4	17
IVS-CRDS	3	2 (5)
IVS-CRF	0	1 (1)

WACO continues the testing and repair of the Mark 5 modules and has started efforts to stand up Mark 6 units and diskpacks. WACO has four Mark 6 units which are usable but not yet online. Out of an initial 128 Mark 6 diskpacks, 32 were shipped to Kokee Park. The correlator staff conditioned the remaining 96 diskpacks and started shipping modules out in late 2017.

### 3 Current Setup

WACO has a dedicated 1 Gbps line for e-transfers and a combined internal and external disk space of around 545 TB to store all data. For incoming data, either e-VLBI or diskpack, 180 TB of storage space was recently added to bring the externally accessible disk space to around 278 TB. In the internal network, WACO has a lustre file system used for correlation with 192 TB and another 79 TB of storage space for backups and local use.

The correlator is made up of several multi-core processing nodes with a combined total of 512 single-threaded cores. Each node has a high-speed fiber line to the lustre file system for data processing and an ethernet line for node management. Additional and identical nodes are used for all post-correlation processing.

Table 2 lists software WACO uses in production. DiFX is used to correlate all IVS data, and WACO uses HOPS and SKED for post-correlation processing. Calc/Solve and nuSolve are used to generate both Mk III and VGOS-style correlation databases, respectively. Tsunami and jive5ab are used for e-transfer of VLBI data. In addition to the versions of the software listed in Table 2, WACO maintains older versions for legacy support.

**Table 2** Software used at WACO as of 1 August 2018.

Software	Version	Used for
DiFX	2.4	Correlation
HOPS	3.17	Fringing
SKED	2018Jul05	Predicted SNR
Calc/Solve	2018Jul13	V001 Database Creation
vgosDbMake	0.5.2	V001 Database Creation
Tsunami	v1.1 build 42	e-transfer
jive5ab	2.8.1	e-transfer

A performance test was conducted using the WACO correlator in early 2018. Figure 1 shows the usual plot of correlation time decreasing as processing power is increased. The use of more processing cores is especially advantageous for multi-station scans, but eventually correlation speed becomes limited by disk IO speed over pure processing power.

### 4 Hardware Refresh

WACO is in the process of configuring a new software correlator which is expected to be up and running in the near future. The current DiFX correlator was configured in 2014, and it can take four to six hours to correlate a typical IVS-R4 experiment. The new correlator will at least double the speed of the current setup and will consist of upgraded hardware, more lustre system storage hosts, and more processing nodes which can be used for simultaneous correlations. Upgraded backend machines and workstations are in the works, as well as a smaller correlator configured for testing purposes. Finally, the high-speed internet line is planned to be upgraded to around 3-4 Gbps.

### 5 Staff

The Washington Correlator is under the management and scientific direction of the Earth Orientation Department of the U.S. Naval Observatory. As of November 2016, the VLBI division is now fully staffed with two new astronomer positions and a contract for two FTE correlator scientists.

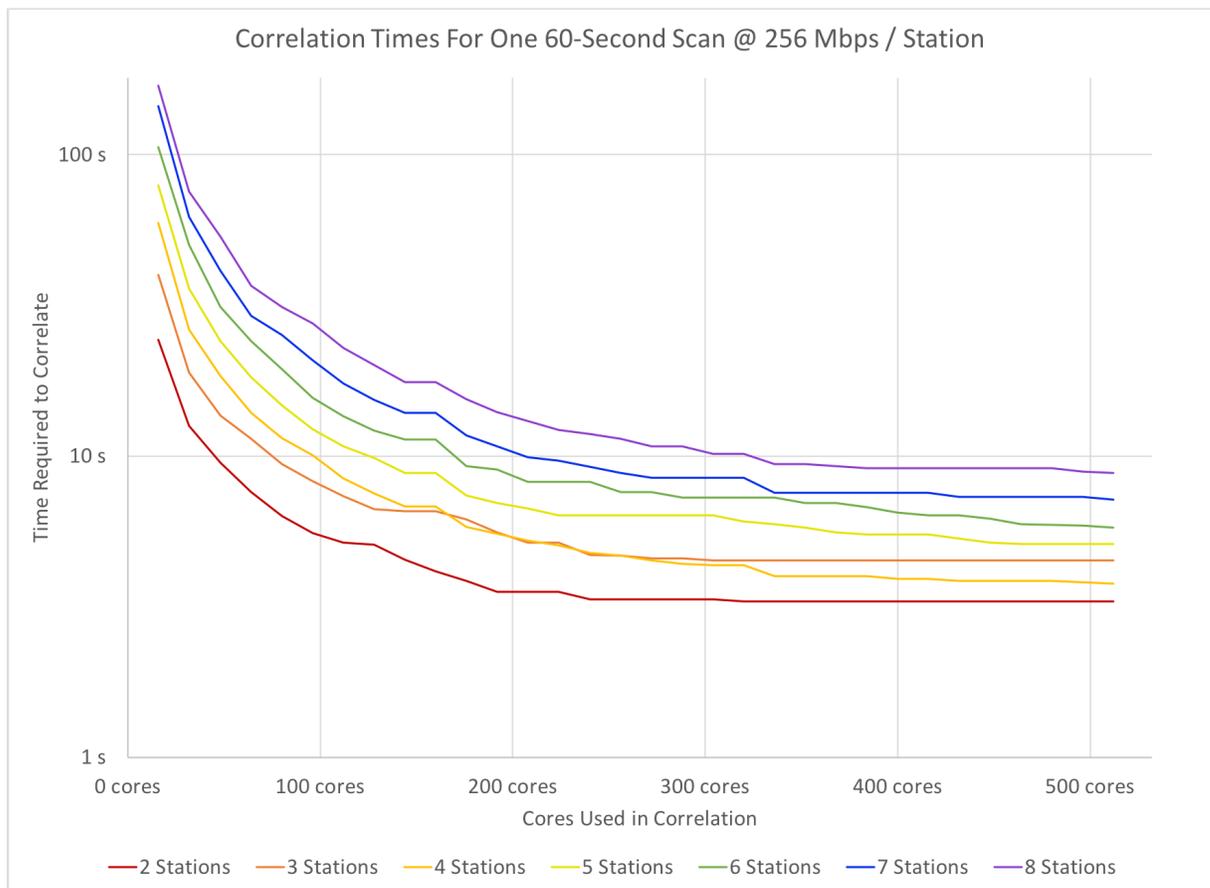


Fig. 1 WACO Performance Test